

67. [Amended] A method of forming a conductor comprising:
- depositing an oxide layer over a planarized surface;
 - etching a trench having a top on the oxide layer;
 - depositing a barrier layer of tantalum nitride on the oxide layer;
 - depositing a seed layer of copper on the barrier layer of tantalum nitride [oxide layer];
 - removing the barrier layer and seed layer from selected areas of the oxide layer, leaving a seed area;
 - depositing a layer of copper on the seed area; and
 - depositing a layer of tantalum nitride above the layer of copper.

IN THE TITLE

The title was objected to as being non-descriptive. Applicant respectfully requests that the Examiner hold this objection in abeyance until allowable subject matter is identified.

REMARKS

Applicant has reviewed and considered the Office action mailed on September 28, 2000, and the references cited therewith.

Claims 50, 54, and 67 are amended, no claims are canceled, no claims are added; as a result, claims 1-77 are pending in the application.

§112 Rejection of the Claims

Claims 54 and 67-77 were rejected under 35 U.S.C. § 112, first paragraph as not being enabled. Applicant has amended claims 50, 54, and 67 to clarify the relationship among the limitations. Claims 50, 54, and 67 were not amended in response to an art rejection. Applicant respectfully submits that claims 54 and 67 are enabled and requests withdrawal of the rejection and reconsideration and allowance of claims 54 and 57.

Claims 68-77 depend from claim 67 and for the reasons stated above and the limitations in the claims applicant respectfully submits that claims 68-77 are enabled. Therefore, applicant requests withdrawal of the rejections and reconsideration and allowance of claims 68-77.

§103 Rejection of the Claims

Claims 1-66 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Dubin et al. in view of Ting et al. Applicant traverses the rejections.

Applicant does not admit that Dubin et al. is prior art or that Ting et al. is prior art and reserves the right to swear behind Dubin et al. and Ting et al. as provided for under 37 C.F.R. 1.131.

The references, to support a 103(a) rejection, must teach or suggest all of the claim elements. Claim 1 recites "depositing an insulator over a planarized surface." Applicant respectfully submits that neither Dubin et al. nor Ting et al. teach or suggest "depositing an insulator over a planarized surface."

The Office action on page 4 states: "Dubin et al. disclose a method of forming a conductor comprising: depositing an insulator 12, as shown in Fig. 1 and recited in Col. 1/11.32-34; ..." However, Dubin et al. at Col 1/11 32-34 states: "Copper wire 16 is formed in a recess 18 defined in a dielectric layer 12. Dielectric layer 12 is typically formed out of silicon dioxide." Applicant respectfully submits that neither of these sentences teach or suggest "depositing an insulator over a planarized surface." Therefore, Dubin et al. does not teach or suggest "depositing an insulator over a planarized surface."

The Office action on page 5 states: "However, Dubin et al. do not deposit insulator layer 12 over a planarized surface." Applicant agrees.

The Office action on page 5 states: "Ting et al. deposit an insulator layer 11 over a planarized upper or bottom surface of metal layer 12, as shown in Fig. 1 and indicated in Col. 8/11.27-36, reciting the structure 10 as shown in Fig. 1 as being only one of many structures present on a semiconductor device." Applicant respectfully disagrees. Ting et al. at Col. 8/11 27-36 states: "Embodiments of the present invention are schematically illustrated in FIGS. 1 through 5, wherein similar elements bear similar reference numerals. Adverting to FIG. 1, an embodiment of the present invention comprises a semiconductor device having an interconnect pattern comprising wiring layer 10 representative of one of the conductive or metal layers in a multiple metal level semiconductor device. It should be understood that structure 10 is only a portion of many structures present on a semiconductor device." So, Ting et al. does not teach or

suggest a planarized surface and does not teach or suggest "depositing an insulator over a planarized surface."

The Office action on page 5 states: "The latter would certainly also include a planarized structure, as is well-known to one of ordinary skill in the art."

Applicant respectfully disagrees. Applicant submits that the statement is not supported in Ting et al., and therefore the statement is based on facts within the personal knowledge of the Examiner. Applicant respectfully requests that the Examiner provide an affidavit as required by MPEP § 2144.03. If the Examiner cannot provide an affidavit, applicant requests withdrawal of the rejection and reconsideration and allowance of claim 1.

The Office action on pages 5 and 6 states: "It would have been obvious to one having ordinary skill in the art at the time of the invention to deposit Dubin's insulator layer 12 over a planarized surface as shown in Ting's Fig. 1, since it is an obvious matter of design choice to have a planarized or unplanarized structure underneath Dubin's insulator layer 12 or Ting's insulator layer 11."

Applicant respectfully disagrees. Applicant submits that the statement is not supported in Ting et al.. Applicant submits that Fig. 1 of Ting et. al. does not show or describe a planarized surface, and therefore the statement is based on facts within the personal knowledge of the Examiner. Applicant respectfully requests that the Examiner provide an affidavit as required by MPEP § 2144.03. If the Examiner cannot provide an affidavit, applicant requests withdrawal of the rejection and reconsideration and allowance of claim 1.

Claim 2 is dependent on claim 1. For reasons analogous to those provided above and the limitations in the claim, applicant respectfully submits that claim 2 is not obvious over Dubin et al. in view of Ting et al. Therefore, applicant requests withdrawal of the rejection and reconsideration and allowance of claim 2.

Claim 3 was not rejected in the Office action. Applicant respectfully requests that the next Office action indicate that claim 3 is allowed.

Claims 4-66 recite depositing a material "on a planarized surface." Since neither Dubin et al. nor Ting et al. teach or suggest this limitation, applicant respectfully submits that the rejections of claims 4-66 are based on facts within the personal knowledge of the Examiner, and

reject with No prior art

applicant requests that the Examiner provide an affidavit as required by MPEP § 2144.03. If the Examiner cannot provide an affidavit, applicant requests withdrawal of the rejections and reconsideration and allowance of claims 4-66.

Claims 13, 16, 21, 24, 28, 31, 35, 39, 43, 46, 51, 57, 61, and 66-77 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Dubin et al. in view of Ting et al. and further in view of Nogami et al. Applicant traverses the rejection.

Applicant does not admit that Nogami et al. is prior art and reserves the right to swear behind Nogami et al. as provided for under 37 C.F.R. 1.131.

Applicant has studied paragraph 10 of the Office action and respectfully submits that with respect to claims 67-77 the Office action does not cite to any specific language in Nogami et al. Therefore, the rejections of claims 66-77 under 35 U.S.C. § 103(a) as being unpatentable over Dubin et al. in view of Ting et al. and further in view of Nogami et al. is not supported in the Office action. Since the rejection of claims 66-77 under 35 U.S.C. § 103(a) are not supported by Nogami et al., applicant requests withdrawal of the rejections and reconsideration and allowance of claims 66-77.

Applicant submits that the following statements used to support the rejections of claims 6, 10, 49, 55, 58, 63, 64, 66, 74, and 75 in the Office action are unsupported in the cited references:

Page 6: "Regarding claim 10, it is well known to one of ordinary skill in the art that polymer (claim 8), polyimide (claim 9) and foamed polymer (claim 10) are equally good as interlayer dielectric (ILD)."

Page 9: "Regarding claims 6 and 66, the limitation that the oxide layer is fluorinated silicon oxide is conventional. Fluorinated silicon oxide and silicon dioxide are known in the art as equivalent alternatives for interlayer dielectric (ILD)."

Page 10: "It would have been obvious to one ordinary skilled in the art at the time the invention was made to select any one of these materials as a suitable Dubin's insulator layer 12 or Ting's insulator layer 11, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability of the intended use as a matter of design choice."

Page 10: "Regarding claims 49 and 55, the limitation that the Al conductive layer is deposited to an amount sufficient to fill the trench is trivial."

Page 10: "Regarding claims 58 and 63, the limitation that the copper seed layer is deposited to a depth of approximately five-hundred angstroms thick, or to five-hundred angstrom below the top of the trench is trivial, since if it is deposited more than the specified amount, it is no longer a seed layer, but a conductive layer."

Page 11: "Regarding claim 64, the limitation that the TaN barrier layer is deposited above the conductor to a depth of approximately five-hundred angstroms is an obvious matter of design choice within skill in the art."

Page 12: "Regarding claim 74, the limitation that the copper conductive layer is deposited to a depth of about five-hundred angstroms below the top of the trench is trivial, since space must be provided for the overlying TaN barrier layer to fill up the trench, as implicated in the parent claim 67."

Page 13: "Regarding claim 75, the limitation that the TaN barrier layer is deposited over the copper conductive layer to a depth of about five-hundred angstroms -- combined with the limitation of claim 74 -- is essentially the same as filling up the trench with Cu conductive layer of claim 74 and TaN barrier layer of claim 75, and hence, is trivial to one of ordinary skill in the art."

Applicant respectfully submits that these statements are unsupported by the references and therefore within the personal knowledge of the Examiner. Therefore, applicant requests that the Examiner provide an affidavit as required by MPEP § 2144.03. If the Examiner cannot provide an affidavit, applicant requests withdrawal of the rejections and reconsideration and allowance of claims 6, 10, 49, 55, 58, 63, 64, 66, 74, and 75.

Information Disclosure Statements

The Office action included Information Disclosure Statements with comments that copies of the cited references had not been received. Applicant is resubmitting the Information Disclosure Statements and copies of the references. The Information Disclosure Statements and copies of the references are being sent to Wynette Stapor of the U.S. Patent and Trademark

Customer Service Department. Applicant respectfully requests that the examiner review the references and initial and return the Information Disclosure Statements with the next Office action.

Conclusion

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney at 612-371-2109 to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

PAUL A. FARRAR

By their Representatives,

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.

P.O. Box 2938

Minneapolis, MN 55402

(612) 371-2109

Date

February 15, 2001

By

Danny J. Padys
Danny J. Padys
Reg. No. 35,635

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Commissioner of Patents, Washington, D.C. 20231, on this 15th day of February, 2001.

Name

Amy Moriarty

Signature

Amy Moriarty